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wherein said thin film transistor has the other/one of its source or drain addressed with said scan signal, and a gate supplied with said data signal.--

REMARKS

Claims 21-37 were pending in the application prior to the above amendment. Claims 33-35 have been amended and new claims 38-40 have been added to provide more complete protection for the invention to which applicant is entitled. Accordingly, claims 21-40 are pending in the application and, for the reasons set forth below, are believed to be in condition for allowance.

Summary of the Invention

The claims of the invention are generally directed to an electro-optical device and a method for driving the same in which a clear, gradated display is achieved by using a plurality of pulses to drive a pixel element. This allows the frame frequency to remain at a level that does not cause undesirable flicker effects while still achieving a gradated display.

Specifically, claim 21 of the present application recites a driving method for an electro-optical device having a plurality of pixels including the steps of addressing the pixels of the device with a scan signal for a predetermined period, and supplying a data signal to each pixel during the addressing with the scan signal, wherein the predetermined period is time-divided into a predetermined number of divisions, and the data signal contains a plurality of pulses, the number of which is determined depending on the tone of the image to be displayed by the pixel.

Claim 26 recites a method for driving an electro-optical device having a plurality of pixels including the steps of addressing the pixels of the device with a scan signal for a predetermined period, preparing original image data in accordance with an image to be displayed, converting the original image data into a data signal containing a plurality of pulses to be supplied to each pixel, the number of pulses being determined by the tone of the image to be displayed, and supplying the data signal to each pixel during the addressing with the scan signal.

Claim 31 recites an electro-optical device including a plurality of pixels arranged in matrix form, addressing means for addressing the pixels, image data production means for producing image data in accordance with an image to be displayed, image data processing means for processing the image data to produce a signal having a number of pulses depending on the tone of the image to be displayed, and data signal supply means for supplying the data signal to the pixels of the electro-optical device.

Prior Art Rejections

Claims 21-32 and 36 are rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent 4,743,096 to Wakai et al. Wakai et al. discloses a liquid crystal video display employing non-linear elements that achieves a gradated display through the use of pulse width modulation. The Official Action asserts that Wakai et al. employs a data signal which consists of "a plurality of pulses and the number of pulses are determined by the tone of an image to be displayed."

For the reasons set forth below, Applicant respectfully asserts that Wakai et al. does not disclose the use of a plurality of pulses where the number of pulses is determined depending on the tone of an image to be

displayed as is disclosed, and claimed, in the present application. Specifically, Applicant believes that Wakai et al. relies on the width of a single pulse to vary the gradation of a display.

In support of this position, Applicant notes that Figure 8 of Wakai et al. shows the data line waveforms produced by the driving circuit disclosed in Wakai et al. (column 4, lines 21-23). As is clearly shown in this Figure, only a single pulse, the width of which is varied depending on the tone of the image to be displayed, is used to drive the video display. Furthermore, Wakai et al. discusses at several points in the specification how a single pulse should be used to drive the video display. Wakai et al. states "the ON pulses of the pulse-width modulation signal from the data line driving circuit appear together as one pulse in the latter portion of each selected period" (column 3, lines 37-40) (emphasis added). Wakai et al. further states that the data line driving signal appears as "one continuous pulse." (column 4, lines 58-61).

The present invention, however, relies upon a plurality of separate pulses to vary the display gradation. Specifically, independent claims 21, 26 and 31 all recite a data signal having a "plurality of pulses." Furthermore, the use of a plurality of pulses in the present invention is particularly advantageous for the reasons set forth at page 5 of the specification. The use of a plurality of pulses results in the electric field in the non-write-in time to be an average of the field applied by the pulses. Therefore, less precise control over the voltage level is required to achieve satisfactory display gradation using the digital device of the present invention.

For the reasons set forth above, Applicant does not believe that Wakai et al. anticipates the claims of the present invention as asserted in the

Official Action and reconsideration of the pending rejection in light of the above discussion is requested.

In addition, it is noted that there is another remarkable difference between the present invention and Wakai et al. in the structure of the pixel. Specifically, the non-linear element 106 (while the Official Action asserts that reference number 106 refers to a pixel, applicant notes that reference number 106 in fact refers to a non-linear element. See column 4, line 45) provided at each pixel in Wakai is a two-terminal element. The use of the driving method disclosed and claimed in the present application, however, is suitable for use with a three-terminal element, such as a thin film transistor.

It is not clear how the driving method claimed in the present application could be utilized in the circuit structure shown in Wakai et al., and Applicant has added new dependent claims 38-40 that specifically recite the use of a thin film transistor for each pixel. These claims further distinguish the present invention from the prior art of record and are believed to be allowable as submitted herewith.

Claims 33-35 are rejected as obvious based on the combination of Wakai et al. and U.S. Patent No. 4,897,639 to Kanayama. The Official Action cites Kanayama only for the teaching of a latch circuit, a ROM table, a flip-flop circuit, and a counter. However, as discussed in detail above, Applicant does not believe that Wakai et al. discloses a device which uses a plurality of pulses to drive an electro-optical display, and Kanayama does nothing to overcome the deficiencies of Wakai et al. Therefore, since the combination of these two references could not produce a device as specifically recited in the claims of the present application, the combination

cannot render the claims obvious. In view thereof, reconsideration of the rejection is requested.

Claim 37 is further rejected as obvious based on the combination of Wakai et al. and U.S. Patent No. 4,021,607 to Amano. Again, Amano is cited merely for its showing of a video receiving system. However, as with claims 33-35 discussed above, Amano does nothing to overcome the deficiency in Wakai et al. Specifically, Amano does not disclose or suggest the use of a plurality of pulses to drive an electro-optical device. Therefore, Applicant does not believe that the combination renders claim 37 obvious, and reconsideration is again requested.

Formalities

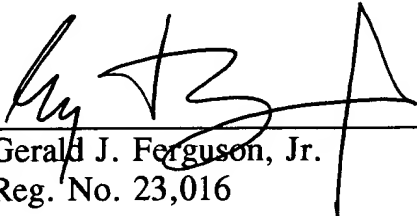
The Official Action rejects claims 33-35 as indefinite under 35 U.S.C. § 112. Specifically, the Official Action asserts that the phrase "image data production means includes a latch circuit" in claim 33, "image data production means includes a ROM table" in claim 34, and "data signal supply means includes a flip-flop circuit and a counter" in claim 35 are unclear since the functions and connections of these elements in the electro-optical device are unclear.

In response, claims 33-35 have been amended to clarify the language objected to by the Examiner. Specifically, these amendments clarify the functions of these elements and connections within the electro-optical device as shown in Figure 25 and the related description at page 36 of the specification. Applicant believes that these amendments are sufficient to place the claims in proper form in accordance with 35 U.S.C. § 112, and reconsideration of the pending rejection is requested.

Conclusion

For all the reasons set forth above, Applicant does not believe that the claims of the present application are anticipated by the prior art of record. The claims of the present invention clearly require a plurality of driving pulses, which is not disclosed or suggested by the prior art. Furthermore, new claims 38-40 recite the use of a thin film transistor (three terminal element) at each pixel, while the prior art discloses only a non-linear element (two terminal element). Finally, claims 33-35 have been amended to place them in proper form with 35 U.S.C. § 112. In view of the above, reconsideration of the pending rejections and a notice of allowance is respectfully requested.

Respectfully submitted,



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